

**CEVE / ESCI / ENST 307 and 507
ENERGY AND THE ENVIRONMENT
SPRING 2017**

Meeting Times and Location:

T/Th 9:25 – 10:40 a.m., SST 106

Instructor:

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Office Hours:

Tuesdays 2-4 p.m. Visits at other times are also welcomed, via email request.

Course Description:

Securing sufficient, reliable, and affordable supplies of energy in an environmentally sustainable manner is among the greatest challenges facing society in the 21st century. Appreciating and addressing this complex challenge requires consideration of the various physical, technological, and societal forces that shape energy use and its impact on the environment.

This course will explore the physical principles of energy and how various sectors and fuels impact Earth's environment and climate. We will also examine policies and technologies that could foster more sustainable use of energy resources. The course will include a group project in which teams of students will design business plans for a particular energy source and assess the associated economic, environmental, regulatory, and practical implications.

Course Objectives and Expected Learning Outcomes:

This course aims not only to impart heightened knowledge of energy and its impacts on the environment, but also to build skills in research, analysis, and critical thinking that will catalyze a lifetime of engagement with this complex topic. Among the learning objectives for this course, students completing this course will be able to:

- 1) Characterize the performance of engines, heat pumps, and power plants
- 2) Identify key environmental impacts of various energy sources
- 3) Compute the energy return on investment, overall efficiency, and resource intensity for an energy source
- 4) Obtain objective, credible data and projections for energy availability, consumption, and impacts, and critically evaluate conflicting estimates
- 5) Conduct in-depth research on an energy topic, and present findings in a presentation or virtual poster
- 6) Design and present a business plan, compute its financial and environmental impacts, and identify its practical and regulatory challenges

The course addresses the following ABET student outcomes for the BSCE degree:

- (a) an ability to apply knowledge of mathematics, science, and engineering;
- (c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability;
- (d) an ability to function on multidisciplinary teams;
- (e) an ability to identify, formulate, and solve engineering problems;
- (f) an understanding of professional and ethical responsibility;
- (g) an ability to communicate effectively;
- (h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context;
- (i) a recognition of the need for, and an ability to engage in life-long learning;
- (j) a knowledge of contemporary issues

Prerequisites:

This course will apply quantitative approaches, scientific principles, and policy analysis to examine energy and the environment. Physics and calculus background at least to the level of PHYS 101 and MATH 101 (or AP equivalents) are required. Please contact the instructor if you have questions regarding your preparation.

Textbook and Readings:

Readings will be made available on the Canvas website for the course.

Honor System Policy:

All students are expected to adhere to the Rice Honor Code. Exams will be given under the honor system and must be entirely a student's own work, using only resources that are explicitly authorized for that exam. Homework assignments may be discussed with other students but must be written individually in your own words. To avoid any possibility of plagiarism, all work must be written entirely in the student's own words, citing all references used and explicitly denoting any quotes in quotations.

Disability Statement:

If you have a documented disability that will impact your work in this class, please contact me to discuss your needs. Additionally, you will need to contact the Disability Support Services Office in the Allen Center.

Grading:

Written assignments (~5)	25%
Midterm Exam	25%
Co-teaching a class	10%
Forum presentation or (virtual) poster	10%
Group presentation	15%
Group paper	15%
Attendance and Participation	up to +/- 3 points on final grade

Assignments:

Assignments may include short essays and analyses based on data obtained from reliable sources such as government websites or peer-reviewed publications. While there will be some textbook-style problems to ensure adequate development of abilities for problem-solving calculations, a key aim of this course is to engage students in critical thinking involving both quantitative and qualitative assessment of emerging scientific literature and available data resources. This higher-level thinking is crucial given the rapidly evolving nature of energy and the environment.

All assignments are due by the end of class on the due date unless otherwise stated. Late assignments will incur a penalty of 25 points and will not be accepted after solutions are distributed. Extensions will be granted only by email request describing specific extenuating circumstances.

Exam:

The midterm exam will be given in a take-home format and will cover the core conceptual material from the course. Date TBD (likely mid-February).

Forums:

Each student will present a talk, a poster, or a virtual poster in one of our forum sessions. These are tentatively scheduled to be held in the class periods before spring break.

Group Projects:

The group projects are a critical component of the course, and will be conducted in groups of three students. Each team will develop a plan that can be implemented to earn a profit or save money while achieving environmental objectives. The plans will be targeted to meeting actual needs of Rice University or local businesses or agencies. Each group will prepare a written report and present its proposal. Details will be provided later.

Attendance and Participation:

Attendance and participation are crucial to the success of this course. While I hope not to need to formally check attendance, basic expectations are:

- Attendance of all classes, except in extenuating circumstances with email note
- Participation in small group discussions
- Full involvement with group project team, including practice session before oral presentation

Points may be added to the final grade for especially active participation in class and/or office hours, or subtracted for not meeting the basic expectations above.

CEVE 507:

Graduate students will complete an additional problem on some assignments, and will have more challenging expectations for other course work. Details TBD based on graduate enrollment in the course.

TENTATIVE SCHEDULE (*subject to change*)

DATE	THEME	TOPIC
1/10	Introduction	The Energy Challenge
1/12	Physical Principles	Energy, work, heat, and power; First Law of Thermodynamics; Efficiency of energy conversions
1/17		Heat Transfer; Second Law of Thermodynamics; Intro to heat engines
1/19		Types of heat engines; Refrigerators and heat pumps
1/24	Evaluation Metrics	Financial metrics
1/26		Energy use and Environmental metrics
1/31	Environmental Challenges	Water, Land and Food*
2/2		Air*
2/7		Climate*
2/9		SPRING RECESS
2/14		Climate (continued)*
2/16		Emission control technologies* (also, RCEL: Tips for presentations)
2/21	Energy Sectors and Policies	Electricity and the Electric Sector*
2/23		Transportation Sector*
2/28		Policy Approaches*
3/2	Forums: Talks and (Virtual) Posters	Forum: Environmental challenges and energy sectors
3/7		Forum: Fossil fuels and nuclear
3/9		Forum: Renewable energy and efficiency
3/13 – 3/17		SPRING BREAK
3/21	Forms of Energy: Fossil and Nuclear	Oil and Natural Gas*
3/23		Coal and Nuclear*
3/28	Forms of Energy: Renewable	Biofuels*
3/30		Solar and Wind*
4/4	Energy efficiency and other options	Efficiency; Energy Storage; Demand Response*
4/6	Presentations**	PRESENTATIONS (Rice oriented)
4/11		PRESENTATIONS (Rice oriented)
4/13		PRESENTATIONS (Other)
4/18		Hydropower, Oceans, Geothermal, Future options*
4/20	Presentations	SYNTHESIS PRESENTATION to Rice officials

* These class periods will feature a mix of lecture by the professor, and presentations and/or active learning led by teams of 3-4 students

** These class periods will be devoted to presentations by teams of 3 students